

REMARKS

Reconsideration of the present application is respectfully requested.

Claims 1 – 43 have been canceled without prejudice. New claims 44 – 73 are presented for examination. These claims recite features that further distinguish the present invention from the art of record. Support for new claims 44 – 73 can be found on, for example, pgs. 10 – 27.

The Examiner has objected to the drawings under 37 CFR 1.83(a) as failing to show every feature of the invention specified in the claims. Specifically, the Examiner has alleged that the drawings fail to show the polishing cloth recited in claims 37, 39, 40 and 43. This objection to the drawings has been rendered *moot* by the cancellation of claims 37, 39, 40 and 43 without prejudice. Therefore, the objection to the drawings will not be discussed.

Claims 25, 30 and 32 have been objected to under 37 CFR 1.75(c) as failing to further limit the subject matter of the previous claim. This objection to the claims has been rendered *moot* by the cancellation of claims 25, 30 and 32 without prejudice. Therefore, the objection to claims 25, 30 and 32 will not be discussed.

Claims 1, 9, 10, 13, 19 and 20 have been rejected under 35 U.S.C. 102(b) as being anticipated by the publication entitled “Mechanochemical Polishing of Silicon Carbide Single Crystal with Chromium (III) Oxide Abrasive” and authored by Kikuchi et al. (Kikuchi). Claims 1, 9, 10, 13, 19 and 20 have been canceled without prejudice. However, Applicant will address this rejection with respect to new claims 44 – 73.

New claim 44 recites the novel embodiment disclosed on, for example, pgs. 9 – 10 in which chromium (III) oxide abrasive grains in conjunction with hydrogen peroxide water form

an oxide on an SIC surface during mechanochemical polishing. The oxide on the SIC surface increases a polishing efficiency.

Kikuchi discloses using chromium (III) oxide abrasive on the SIC surface during polishing. However, Kikuchi fails to disclose using hydrogen peroxide water to form an oxide.

Therefore, because Kikuchi fails to disclose using hydrogen peroxide water to promote the formation of an oxide, claim 44 should be in a condition for allowance.

Claims 45 – 60 depend from claim 44. Therefore, these claims should be in a condition for allowance for the above-mentioned reasons with respect to claim 44.

New independent claim 61 recites the novel features discussed above in apparatus form. Therefore, new claim 61 should be in a condition for allowance for the above-mentioned reasons with respect to claim 44.

Claims 62 – 69 depend from claim 61. Therefore, these claims should be in a condition for allowance for the above-mentioned reasons with respect to claim 61 (claim 44).

New independent claim 70 also recites the novel features discussed above. Therefore, new claim 70 should be in a condition for allowance for the above-mentioned reasons with respect to claim 44.

Claims 71 – 73 depends from claim 70. Therefore, claims 71 – 73 should be in a condition for allowance for the above-mentioned reasons with respect to claim 70 (claim 44).

Claims 1 - 4, 14, 15, 20 and 21 have been rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,800,577 to Kido (Kido) in view of U.S. Patent No. 5,750,434 to Urushidani et al. (Urushidani). Claims 1 – 4, 14, 15, 20 and 21 have been canceled without prejudice. However, Applicant will address this rejection with respect to new claims 44 – 73.

New claim 44 recites the novel embodiment discussed above.

Kida discloses a polishing composition that includes hydrogen peroxide as an oxidizing element and an abrasive grain for polishing. (See Col. 5, Lines 2 – 5 and Col. 6, Line 39.) However, Kida fails to disclose or teach of using chromium (III) oxide as an abrasive grain for polishing.

Urushidani discloses using chromium (III) oxide abrasive to polish a silicon carbide substrate. (See Col. 2, Lines 47 – 50.) However, Urushidani fails to disclose or teach of utilizing hydrogen peroxide as an oxide element during the polishing.

The Examiner has alleged that it would have been obvious to one of ordinary skill of the art to have modified the composition of Kido with the abrasive grains of Urushidani. Applicant respectfully traverses this allegation.

Urushidani teaches away from using hydrogen peroxide water to form an oxide on the silicon carbide substrate. A *prima facie* case of obviousness may be rebutted by showing that the art, in any material respect, teaches away from the claimed invention. (See MPEP 2144.05 III, Aug. 2001.)

Urushidani states that “[i]f an oxide...is formed on the silicon carbide substrate, electric fields concentrate on the defective parts (such as flaws or cracks) created by polishing, and cause the characteristics of the electronic device to deteriorate.”¹ (See Col. 1, Lines 49 – 52.) Applicant respectfully questions why one skilled in the art would be motivated to utilize an oxide during polishing in view of the above statement.

One skilled in the art would not have been motivated to modify the composition of Kido to include the chromium (III) oxide abrasive grains of Urushidani because there is no suggestion,

teaching or motivation within Kido to use the chromium oxide abrasive grains of Urushidani. There must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. (See In re Vaeck, 947 F.2d 488 (Fed. Cir. 1991), cited in MPEP 2142, Aug. 2001.)

Kido discloses an exhaustive list of possible abrasive grains for the polishing composition. Specifically, Kido discloses “aluminum oxide, silicon oxide, titanium oxide and zirconium oxide” as possible abrasive grains. (See Col. 6, Lines 62 – 64.) Kido further states that the abrasive grains must contain “little impurities which cause deterioration in properties of semiconductor device...” (See Col. 6, Lines 60 – 62.) There is no language that would motivate one skilled in the art to experiment with different possible abrasive grains.

Therefore, one skilled in the art would not be motivated to substitute chromium oxide abrasive grains for those stated in Kido. If the Examiner wishes to maintain this rejection, Applicant respectfully requests the Examiner to cite a specific reference that provides motivation to substitute chromium oxide as an abrasive grain in conjunction with hydrogen peroxide as required by MPEP 2144.03 (Aug. 2000).

One skilled in the art would not have been motivated to modify the method of polishing disclosed in Urushidani to include the oxidizing elements of Kido because there is no suggestion, teaching or motivation within Urushidani to use the oxidizing elements of Kido. (See In re Vaeck.)

Urushidani discloses that polishing with only chromium oxide results in a nearly flawless surface. (See Col. 3, Lines 12 – 14.) Applicant respectfully questions why one skilled in the art

¹ It is not entirely clear if Urushidani is attempting to avoid oxide formation during polishing, or is only attempting to avoid

would be motivated to experiment with modifying the process of Urushidani when it already results in a nearly flawless surface.

It would not have been obvious to one of ordinary skill of the art to have modified Kido to use the chromium (III) oxide abrasive grains of Urushidani because there would have been no reasonable expectation of success. Evidence showing that there was not reasonable expectation of success may support a conclusion of nonobviousness. (See In re Rinehart, 531 F.2d 1048 (CCPA 1976), cited in MPEP 2143.02, Aug. 2001.)

Kido discloses utilizing hydrogen peroxide as an oxidizing agent to directly oxidize metal. (See Col. 5, Lines 3 – 5 and Lines 14 – 15.) If a silicon carbide wafer was polished with hydrogen peroxide, as taught by Kido, without chromium (III) oxide, no oxidation reaction would occur. Chromium (III) oxide is necessary for an oxidation reaction to occur.

Therefore, one skilled in the art would not be motivated to believe that utilizing hydrogen peroxide, as taught by Kido, would improve the oxidation reaction that occurs when chromium (III) oxide is being used to polish silicon carbide because there would be no expectation of success.

Kido teaches away from using chromium oxide abrasive grains of Urushidani to form an oxide. A *prima facie* case of obviousness may be rebutted by showing that the art, in any material respect, teaches away from the claimed invention. (See MPEP 2144.05 III, Aug. 2001.)

Kido discloses utilizing hydrogen peroxide as an oxidizing agent and an exhaustive list of possible abrasive grains for the polishing composition. Specifically, Kido discloses “aluminum oxide, silicon oxide, titanium oxide and zirconium oxide” as possible abrasive grains. By disclosing such an exhaustive list, Kido implicitly teaches away from using chromium (III) oxide

forming oxide on a defective surface subsequent to polishing.

as an abrasive grain.

Utilizing hydrogen peroxide water to form an oxide layer in conjunction with chromium (III) oxide during polishing leads to unexpected and superior results. More specifically, the oxide layer leads to a reduced processing pressure. (See Pg. 10, Lines 5 – 8.) A *prima facie* case of obviousness is rebutted by proof of unexpected or superior results. (See MPEP 2144.09 Aug. 2001).

In summary, one skilled in the art would not have been motivated to modify Kido in view of Urushidani because: (1) Both references teach away from each other; (2) There is no motivation to experiment with different abrasive grains; (3) There is no motivation to utilize hydrogen peroxide in the method disclosed in Urushidani; (3) There would be no reasonable expectation of success; and (4) The present invention leads to unexpected and superior results.

In view of the above conclusion, claim 44 should be in a condition for allowance.

Claims 45 – 60 depend from claim 44. Therefore, these claims should be in a condition for allowance for the above-mentioned reasons with respect to claim 44.

New independent claim 61 recites the novel features discussed above in apparatus form. Therefore, new claim 61 should be in a condition for allowance for the above-mentioned reasons with respect to claim 44.

Claims 62 – 69 depend from claim 61. Therefore, these claims should be in a condition for allowance for the above-mentioned reasons with respect to claim 61 (claim 44).

New independent claim 70 also recites the novel features discussed above. Therefore, new claim 70 should be in a condition for allowance for the above-mentioned reasons with respect to claim 44.

Claims 71 – 73 depend from claim 70. Therefore, claims 71 – 73 should be in a condition for allowance for the above-mentioned reasons with respect to claim 70 (claim 44).

Claims 5 – 11, 13, 16, 17, 22 – 25, 29, 30 and 32 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Kido in view of Urushidani, and further in view of U.S. Patent No. 5,674,104 to Graebner et al. (Graebner). Claims 5 – 11, 13, 16, 17, 22 – 25, 29, 30 and 32 have been canceled without prejudice. However, Applicant will address this rejection with respect to new claims 44 – 73.

Applicant repeats the arguments made above with respect to the 103(a) rejection over Kido in view of Urushidani. Therefore, in view of the above-discussed arguments, claims 44 – 73 should be in a condition for allowance.

Further regarding the 103(a) rejection over Kido in view of Urushidani, and further in view of Graebner, the Examiner has alleged that it would have been obvious to one of ordinary skill in the art to have further modified the prior art (Kido in view of Urushidani) in view of Graebner. Applicant respectfully traverses this allegation.

Graebner discloses a method for polishing surfaces of diamond. Among all known materials, diamonds have the highest mechanical hardness. (See Graebner Col. 1, Lines 12 – 13.) Therefore, extraordinary steps must be taken in polishing a diamond surface. In comparison, Kido and Urushidani disclose polishing methods for silicon wafers. Applicant respectfully questions why one of ordinary skill in the art would be motivated to utilize the steps disclosed for polishing a diamond surface to polish a silicon wafer. If the Examiner wishes to maintain this rejection, Applicant respectfully requests the Examiner to cite a specific reference that provides motivation to utilize the steps required for polishing a diamond surface to polish a silicon wafer as required by MPEP 2144.03 (Aug. 2000).

In view of the above, claim 44 should be in a condition for allowance.

Claims 45 – 60 depend from claim 44. Therefore, these claims should be in a condition for allowance for the above-mentioned reasons with respect to claim 44.

New independent claim 61 recites the novel features discussed above in apparatus form. Therefore, new claim 61 should be in a condition for allowance for the above-mentioned reasons with respect to claim 44.

Claims 62 – 69 depend from claim 61. Therefore, these claims should be in a condition for allowance for the above-mentioned reasons with respect to claim 61 (claim 44).

New independent claim 70 also recites the novel features discussed above. Therefore, new claim 70 should be in a condition for allowance for the above-mentioned reasons with respect to claim 44.

Claims 71 - 73 depends from claim 70. Therefore, claims 71 – 73 should be in a condition for allowance for the above-mentioned reasons with respect to claim 70 (claim 44).

Claims 12, 27, 34 – 39 and 40 – 43 have been rejected under 35 U.S.C. 103(a) as being unpatentable over the Prior Art (Kido in view of Urushidani and Graebner) in view of U.S. Patent No. 5,816,900 to Nagahara et al. (Nagahara). Claims 12, 27, 34 – 39 and 40 – 43 have been canceled without prejudice. However, Applicant will address this rejection with respect to new claims 44 – 73.

Applicant repeats the arguments made above. Therefore, in view of the above-discussed arguments, claims 44 – 73 should be in a condition for allowance.

Claims 18, 19, 28, 31 and 33 have been rejected under 35 U.S.C. 103(a) as being unpatentable over the Prior Art (Kido in view of Urushidani and Graebner) in view of U.S. Patent No. 6,012,967 to Satake et al. (Satake). Claims 18, 19, 28, 31 and 33 have been canceled

without prejudice. However, Applicant will address this rejection with respect to new claims 44 – 73.

Initially, Applicant requests that the Examiner specify under which section of 35 U.S.C. 102 the present 103(a) rejection is based.

Applicant repeats the arguments made above. Therefore, in view of the above-discussed arguments, claims 43 – 73 should be in a condition for allowance.

Claim 26 has been rejected under 35 U.S.C. 103(a) as being unpatentable over the Prior Art (Kido in view of Urushidani and Graebner) in view of U.S. Patent No. 6,012,966 to Ban et al. (Ban). Claim 26 has been canceled without prejudice. Therefore, this rejection will not be discussed.

Claims 2 – 11, 13 – 17, 19 – 25, 29, 30, 32, 34 and 36 – 39 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Kikuchi in view of U.S. Patent No. 6,270,395 to Towrey et al. (Towrey). Claims 2 – 11, 13 – 17, 19 – 25, 29, 30, 32, 34, and 36 – 39 have been canceled without prejudice. However, Applicant will address this rejection with respect to new claims 44 – 73.

As discussed above with respect to the 102(b) rejection, Kikuchi discloses using chromium oxide to polish silicon, but fails to disclose utilizing hydrogen peroxide water as an oxidizing agent.

Towrey discloses polishing a dielectric with metal oxide particles (Al_2O_3 , SiO_2 , TiO_2) and utilizing hydrogen peroxide as an oxidizing agent. However, the metal oxide particles are not used as a catalyst for oxide formation. Rather, the metal oxide particles merely remove material. Assuming *arguendo* that one skilled in the art would substitute chromium oxide as one

of the metal oxide particles, the chromium oxide would still not serve as a catalyst for an oxidation reaction because low dielectric material rather than silicon carbide is being polished.

Therefore, because Kikuchi in view of Towrey fails to disclose or teach of a catalyst for an oxidation reaction, claims 44 – 71 should be in a condition for allowance.

Further regarding the 103(a) rejection by Kikuchi in view of Towrey, the Examiner has alleged that it would have been obvious to one of ordinary skill of the art to have modified the method of Kikuchi with the oxidizing agent of Towrey to enhance the chemical mechanical process. Applicant respectfully traverses this allegation.

There is no suggestion in Towrey that hydrogen peroxide will benefit the oxidation reaction that occurs when silicon carbide is polished with chromium because low dielectric material is being polished in Towrey, and no catalyst is involved. Therefore, one skilled in the art would not have been motivated to modify Kikuchi in view of Towrey. (See In re Vaeck.)

Therefore, new claims 44 – 73 should be in a condition for allowance.

Claims 12, 27, 35 and 40 – 43 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Prior Art (Kikuchi in view of Towrey) and further in view of U.S. Patent No. 5,816,900. Claims 12, 27, 35 and 40 – 43 have been canceled without prejudice. However, Applicant will address this rejection with respect to new claims 44 – 73.

New claims 44 – 73 should be in a condition for allowance in view of the above-made arguments with respect to the 102(b) rejection.

Claims 18, 19, 28, 31, and 33 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Prior Art (Kikuchi in view of Towrey) and further in view of Satake. These claims have been canceled without prejudice. However, Applicant will address this rejection with respect to new claims 44 – 73.

New claims 44 – 73 should be in condition for allowance in view of the above-made arguments with respect to the 102(b) rejection.

Claim 26 has been rejected under 35 U.S.C. 103(a) as being unpatentable over Prior Art (Kikuchi in view of Towery) and further in view of U.S. Patent No. 6,012,966 to Ban et al. Claim 26 has been canceled without prejudice. However, Applicant will address this rejection with respect to new claims 44 – 73.

New claims 44 – 73 should be in condition for allowance in view of the above-made arguments with respect to the 102(b) rejection.

A petition for a two-month extension of time along with a check for the requisite petition fee is being submitted concurrently with the present amendment. Although no additional fees are believed to be due, permission is given to charge any unanticipated fees to Deposit Account 50-1147.

In view of the above amendments and remarks, the present application is now believed to be in condition for allowance. A prompt notice to that effect is respectfully requested.

Respectfully submitted,



Kerry S. Culpepper
Reg. No. 45,672

Law Offices of David G. Posz
2000 L Street, NW
Suite 200
Washington, DC 20036
(202) 416-1638
Customer No. 23400